Florida Keys: Evaluations for Stormwater Contributions was released. The report assessed previously identified stormwater concerns, documented the results of field visits, and defined the areas most likely to have stormwater-associated problems. Stormwater systems in Monroe County are regulated through Monroe County Code Section 9.5-293.

In contrast with *Hot Spots*, *Cold Spots* were defined as areas where onsite systems will continue to operate. *Cold Spots* fall into two categories:

- Properties with unknown systems that must replace or upgrade their systems immediately with an onsite wastewater nutrient reducing system (OWNRS). All these systems must be replaced or upgraded by July 12, 2003.
- Properties that currently have permits for their onsite systems and will not be required to upgrade or replace them until 2010, when all onsite systems must be upgraded or replaced with nutrient reduction OWNRS to meet the regulatory effluent limits described below.

1.1.5 Applicable Regulatory Requirements

As a result of concerns regarding water quality in the Keys, the Monroe County Year 2010 Comprehensive Plan (1997) mandated nutrient loading levels be reduced in the Keys marine ecosystem by the year 2010. In 1998, the Florida Governor issued Executive Order 98-309 which directed local and State agencies to coordinate with Monroe County to implement the Year 2010 Comprehensive Plan and eliminate cesspits, failing septic systems, and other substandard on-site sewage systems.

In 1999 the Florida Legislature set statutory effluent standards and associated compliance schedules for wastewater treatment systems in Monroe County. These standards address treatment for several water quality constituents and require best available technology (BAT) standards for flows less than 100,000 gpd and advanced wastewater treatment (AWT) standards for design flows greater than 100,000 gpd. Adopted water quality standards are listed below.

Water Quality Standards

Constituent	BAT (mg/L)	AWT (mg/L)
Biological Oxygen Demand (BOD5)	10	5
Total Suspended Solids (TSS)	10	5
Total Nitrogen (TN)	10	3
Total Phosphorus (TP)	1	1

Statutory compliance schedules for wastewater treatment systems in the county are listed below.

- All unknown (or unpermitted) onsite systems in "*Cold Spots*" and new installations shall be replaced or upgraded with an OWNRS by July 12, 2003.
- All existing onsite systems shall cease discharging or shall be upgraded to an OWNRS by July 1, 2010.

- All existing onsite wastewater treatment facilitys must be upgraded to either BAT or AWT effluent standards by July 1, 2010.

In 1998, additional legislation addressed wastewater concerns in the Keys by amending the enabling legislation of the Florida Keys Aqueduct Authority (FKAA), the principal potable water supplier for the Keys. Legislation was passed (F.L. 76-441) to strengthen FKAA involvement in wastewater management for Monroe County. A Memorandum of Understanding (MOU) between Monroe County and the FKAA was signed to "request that the FKAA exercise its authority to purchase, finance, construct, and otherwise acquire and to improve, extend, enlarge, and reconstruct a wastewater collection, transmission, treatment, and disposal system or systems in the Florida Keys." A chronological summary of these and other events relevant to wastewater management in the Keys is presented in Table 1-1.

Table 1-1. Recent Chronology of Regulatory Milestones of Wastewater Management in the Florida Keys

1993	• Initial adoption of Monroe County Year 2010 Comprehensive Plan.
1997	• Monroe County Comprehensive Plan amended to comply with Florida Statutes. • Administration Commission adopts amendments to Monroe County Year 2010 Comprehensive Plan and established Five-Year Work Program (Rule 28-20.100). • Monroe County Stormwater Management Plan (MCSWMP) begins. • Monroe County established original Identification and Elimination of Cesspools Ordinance, 03-1997; this ordinance was unsuccessful and was later rescinded.
1998	• Governor's Executive Order 98-309 (State and Local Agency Participation in Carrying Out Monroe County Year 2010 Plan). • Florida Legislature amends the enabling legislation of the FKAA (F.L. 76-441) to reinforce the FKAA's involvement in wastewater for Monroe County. • Monroe County enters into a Memorandum of Understanding with the FKAA requesting that the FKAA exercises its authority to finance, construct, and operate wastewater systems in the Keys.
1999	• Governor Bush and his cabinet amend the 1997 Five-Year Work Program (Rule 28-20.100) to accelerate pace of program, identify "*Hot Spots*," and initiate cesspool identification outside of "Hot Spot" areas. • Monroe County passes Ordinance 031-1999 (Revised Identification and Elimination of Cesspools) to comply with the Governor's revised Five-Year Work Program. • F.L. 99-395 passed (new requirements for all sewage treatment, reuse and disposal facilities, and all on-site systems in Monroe County; prohibits new or expanded discharges into surface waters, and requires existing surface water discharges be eliminated before July 1, 2006).
Source: Modified from Monroe County, 2000	

In addition to local regulations, Section 303(d) of the Clean Water Act (CWA) requires all states to develop a list of priority surface waters that do not meet applicable water quality standards (impaired waters) after implementation of technology-based effluent limitations. States are required to establish Total Maximum Daily Loads (TMDLs) which designate the maximum amount of a pollutant a waterbody can assimilate without exceeding water quality standards.

Chapter 99-223, Laws of Florida, sets forth the process by which the 303(d) list is refined through more detailed water quality assessments. It also establishes the means for adopting TMDLs, allocating pollutant loadings among contributing sources, and implementing pollution reduction strategies. Implementation of TMDLs can include any combination of regulatory, non-regulatory, or incentive-based actions necessary to reduce the pollutant loading. Non-regulatory or incentive-based actions may include development and implementation of Best Management Practices (BMPs), pollution prevention activities, and habitat preservation or restoration. Regulatory actions may include issuance or revision of wastewater, stormwater, or environmental resource permits necessary for consistency with the TMDL. Permit conditions may be quantitative effluent limitations or, for technology-based programs, a combination of structural and non-structural BMPs necessary for achieving the desired pollutant load reduction.

Florida is comprised of fifty-two major hydrologic basins, which in turn make up five TMDL groups, each of which undergoes five phases of development, beginning with basin assessment and concluding with actual implementation. The five phases of the study for each group are as follows:

- Phase I Preliminary Basin Assessment
- Phase II Strategic Monitoring
- Phase III Data Analysis and TMDL Development
- Phase IV Management Action Plan
- Phase V Implementation

The Keys are in the fifth group of waterbodies to undergo TMDL implementation and are scheduled to begin Phase I in fiscal year 2004/2005 and complete it by fiscal year 2008/2009. Currently, Phase II for waterbodies in Group I was completed in April of 2002. The results of the five phases for Group 5 cannot be predicted at this early date and as such, consideration to TMDLs has not been given in this Program.

1.2 Plan Formulation Memorandum

Previously developed wastewater and stormwater master plans developed by local municipalities in Monroe County provide the individual plans necessary for implementation of the FKWQIP and also alleviate the need for the Corps to develop additional planning documents. Therefore, the Memorandum is necessary to provide the documentation of the analyses and subsequent recommendations of the plans.

1.2.1 Purpose of Memorandum

The purpose of this Memorandum is to document the analyses and planning processes used in developing the various master plans and other documents prepared to date for Monroe County and municipalities within Monroe County with regard to wastewater improvements and stormwater management planning. Based on the extensive work undertaken to date in the identification of potential alternatives and recommended plans, no additional plan formulation work will be undertaken by the Corps as part of the FKWQIP. Consequently, the purpose of this

memorandum is to summarize the decision-making process used in each master plan or other relevant documents, and to document the recommendations made as part of each plan.

1.2.2 Memorandum Organization

Chapter 2 of this Memorandum outlines the range of alternatives considered within the previously prepared master plans and other reviewed documents and also summarizes the decision making process used to select the recommended action(s) within each plan. Chapter 3 provides an overview of available cost information. Chapter 4 presents conclusions regarding decision making processes for future wastewater and stormwater treatment plans in Monroe County as well as the future use of this Memorandum.

1.2.3 Master Plans and Other Documents Reviewed

Several stormwater and wastewater master plans have been prepared for Monroe County and other municipalities located within Monroe County. The Corps plans to use these decision making documents as the foundation for the planning component of the FKWQIP. Since 1994, several plans and documents have been produced and were reviewed for inclusion in this Memorandum. Descriptions of each plan are provided below.

1.2.3.1 Wastewater

Draft Wastewater Facilities Plan with Phased Implementation for the Marathon Area of the Florida Keys (Marathon Wastewater Facilities Plan). CH2MHill, Inc. *et al.* 1998. The purpose of this Plan was "to define the most cost-effective, environmentally sound, and implementable program for the management of existing and future wastewater pollutants that presently act, or will act, to deteriorate the Key's water quality in the Marathon area." The planning area extended from Seven Mile Bridge through Conch Key (see Figure 1). Implementation of the wastewater management system was comprised of "planning, design, and construction" and the scope was defined as part of *Construction Grants, 1985*, a manual published by EPA (July 1984).

Design/Build/Operate Wastewater Management System (DBOWMS) for the City of Marathon, FL. FKAA 1998. This plan presented a set of specifications that accompanied a Request for Proposals (RFP) for the Design/Build/Operate Wastewater Management System for the City of Marathon, FL. The specifications were intended to establish minimum technical requirements and level of quality for the treatment system to be constructed and operated for the City.

Monroe County Sanitary Wastewater Master Plan. CH2MHill, Inc. *et al.* 2000. The objective of this master plan was to "develop a plan that would provide an equitable, ecologically sound, and economical implementation strategy for managing wastewater and improving the water quality in the Florida Keys." Goals of the plan were to "provide responsive, flexible, and cost-effective solutions that improve wastewater management throughout the keys and satisfy existing and future needs of the community," address affordability and equity issues, and satisfy environmental and regulatory criteria and guidelines. The planning area included the entire developed area of the Florida Keys, except for the Cities of Key West and Key Colony Beach (see Figure 1).

City of Marathon Reuse Component of Central Wastewater RFP. Calvin, Giordano & Associates, Inc 2001. The purpose of the requested work was "to determine water reuse feasibility for the City of Marathon." The scope of this study was based on the FDEP *Guidelines for Preparation of Reuse Feasibility Studies for Applicants Having Responsibility for Wastewater Management.*

City of Key Colony Beach Sewer System Evaluation. URS Corporation 2002. The City had "continuously expended funds" over the last five years in rehabilitating their existing wastewater collection system and this evaluation was prepared to assist the City wastewater system staff in identifying additional sources of inflow and infiltration in the existing wastewater system.

Federal Emergency Management Agency (FEMA) Draft Programmatic Environmental Assessment. FEMA has received grant applications to fund the construction of several wastewater treatment systems in Monroe County. Much of the proposed project funding would be provided through FEMA 1249-DR Post Disaster – Unmet Needs funds. Matching funds will be provided through the Florida Division of Emergency Management and local government applications. While the Environmental Assessment prepared in September of 2002 was programmatic in nature, it was written to address the environmental consequences of constructing four planned wastewater treatment projects.

1.2.3.2 Stormwater

Stormwater Runoff Study prepared for the City of Key West. Kissinger, Campo and Associates Corp. (KCA) 1994. The purpose of this study was to identify and map existing flooding locations and develop a Drainage Improvement Development Plan.

City of Key West Water Quality Improvement Program. City of Key West 1999. The intent of this program was to facilitate a commitment by the City to "divert stormwater runoff from Outstanding Florida Waters," reduce infiltration, inflow, and exfiltration in their sewer system.

Islamorada Village of Islands, Stormwater Management Master Plan. Law Engineering and Environmental Services, Inc. 2000. This master plan was developed to "address water quality improvements to stormwater discharges into the Village's canals and near shore waters of the Atlantic Ocean and Florida Bay." The planning area consisted of the Village of Islands, which extends from the north side of the Islands, at Mile Marker 90.94, south to Mile Marker 72.66, and consists of Plantation Key, Windley Key, Upper Matecumbe Key, and Lower Matecumbe Key (see Figure 1).

City of Key West Long Range Stormwater Utility Plan. City of Key West 2001. This plan was developed to review studies previously prepared by KCA and CH2MHill as well as problems associated with flooding since 1994, and make recommendations for future projects and funding required to alleviate flooding and improve water quality in and around the City of Key West.

Monroe County Stormwater Management Master Plan. Camp, Dresser & McKee, Inc. 2001. This master plan, like those previously described, was prepared to "assess the adequacy of

existing systems, prioritize stormwater management needs for each island, identify regulations and policy needs, and develop a plan to finance the construction, operation and maintenance (O&M) of required facilities" for the Keys.

2.0 ALTERNATIVES SELECTION AND ANALYSIS

A Programmatic Environmental Impact Statement (PEIS) is presently being prepared to meet Federal National Environmental Policy Act (NEPA) documentation requirements for the FKWQIP. One component of the PEIS is the analysis of alternatives for the FKWQIP. However, because the document being prepared is a programmatic level EIS, individual EISs will eventually be required for each treatment facility proposed.

This Section of the Memorandum provides the basis for the proposed alternatives and describes the decision making process used to make recommendations regarding alternatives and summarizes the recommendation(s) made as part of each master plan or other decision document. Individual wastewater treatment and stormwater management alternatives were identified as part of the various master plans and other documents previously developed to address wastewater treatment and stormwater management needs in the Florida Keys.

2.1 Monroe County Sanitary Wastewater Master Plan

The Monroe County Year 2010 Comprehensive Plan mandated that a sanitary wastewater master plan be prepared to determine acceptable levels of sanitary service and treatment for all developed and undeveloped areas of Monroe County. More specifically, the plan included the items listed below.

- Establish more stringent nutrient limits to ensure that maximum, tolerable, nutrient loads to the County's nutrient-sensitive waters and ecosystems are not exceeded and short-or-long-term adverse impacts do not occur.
- Prevent further degradation to groundwater, as well as confined, nearshore, and offshore waters.
- Ensure improvements of these waters to levels that have been demonstrated to support healthy, diverse, and productive populations of fish and other marine resources.

The Monroe County Sanitary Wastewater Master Plan is the result of a comprehensive three-year study effort, which included extensive evaluations of existing treatment systems in the Florida Keys and applicable technologies that would fulfill the objectives of the Monroe County 2010 Comprehensive Plan. The master plan was prepared as an initial step towards satisfying directives of this plan

The planning area for this master plan included the entire developed area of the Florida Keys, with the exceptions of the Cities of Key West and Key Colony Beach (see Figure 1). During the study, the Islamorada Village of Islands and the City of Marathon were incorporated. Thus, the planning area included unincorporated Monroe County in the Florida Keys, as well as the cities of Layton, Marathon, and Islamorada Village of Islands.

2.1.1 Existing Wastewater Treatment and Collection Facilities in the Keys

Except for the cities of Key West and Key Colony Beach, where regional wastewater systems are in operation, wastewater facilities throughout most of Monroe County have been built with limited consideration of regional wastewater planning. In the absence of regional wastewater utilities, private onsite or package wastewater treatment facilities have been constructed to serve a development or individual homes. As a result, there is presently a mix of approximately 23,000 onsite systems and 246 small wastewater treatment facilities. Although the existing wastewater collection systems are inadequate for regional wastewater transmission, they could be used to provide source collection and transmission to a regional collection system.

Recommendation. The Monroe County master plan recommended existing collection systems and lift stations remain under private ownership because upgrading these facilities to standards required for a regional utility would be too costly.

2.1.2 Water Quality *Hot Spots*

A goal of the Monroe County master plan is to coordinate the Cesspool Identification and Elimination Ordinance with the master planning efforts. This 1999 Ordinance calls for the establishment of water quality "*Hot Spots*" that identify areas anticipated to be served by central community wastewater systems within the next 10 years or by the year 2010.

Recommendation. The recommendation made in the Monroe County master plan was that wastewater treatment and collection system improvements be located in "*Hot Spots*" as defined by the Monroe County Ordinance governing Cesspool Identification and Elimination (1999).

2.1.3 Estimated Flow Volume During Planning Period

The planning period addressed by the Monroe County master plan was the 20-year interval between 1998 and 2018. Projected wastewater flows and numbers of customers were estimated using FKAA water use records for each of the 27 master plan study areas for the baseline year 1998. Wastewater flow projections were then made based on anticipated growth for the 10-year and 20-year planning horizons (i.e., 2008 and 2018 respectively). Wastewater flow was assumed to be equal to water use at each residential and commercial location.

Recommendation. The recommendation in the Monroe County master plan was to base planning estimates on a seven percent in total wastewater flow for the first 10-year planning period and a 14 percent increase in total wastewater flow in all 27 study areas for the entire 20-year planning period.

2.1.4 Monroe County Wastewater Management Alternatives Screening Process

The decision making (or priority) model approach implemented for the Monroe County master plan incorporated technical information related to wastewater treatment, as well as cost and schedule data. This information was evaluated in tandem with concerns expressed by key

decision makers, stakeholders, and the public, and used to reach consensus on a recommended plan. A two-step process was implemented.

1. Screen potential land areas for possible facility siting.
2. Evaluate the wastewater management alternatives.

Decision models were developed through a joint, collaborative effort among Sanitary Wastewater Master Plan Technical Advisory Committee (SWMP TAC), Monroe County Citizens Task Force on Wastewater (Task Force), and the Monroe County Board of County Commissioners (BOCC), as well as through consultation with representatives of the community-at-large. The process resulted in the identification of alternatives that reflected the concerns of stakeholders and the technical feasibility of treatment solutions.

In evaluating wastewater management alternatives for Monroe County, decision-makers considered multiple issues: cost, technical feasibility, performance, environmental impacts, service disruption potential, reliability, and implementation. Policy concerns and differences in opinion among the stakeholder community were addressed and resolved as objectively as possible. The process provided a means of evaluating alternatives against a common framework and identified factors that most strongly influenced alternative rankings.

The evaluation model examined wastewater treatment alternatives. The first level of evaluation examined the principal objective: maximize benefits of the wastewater management alternative. The second level addressed important issues identified by stakeholders, while the ability of each alternative to meet the program objective was evaluated at the third level.

The Wastewater Management Alternatives Screening Process implemented for the Monroe County Master Plan is summarized below.

- Identify Alternatives. 43 alternatives were identified.
- Preliminary Screening. Each of the 43 alternatives were scored for their ability to meet criteria in each of 7 screening areas.
- Alternative Shake-Out. Alternatives that did not meet criteria were eliminated from further evaluation.
- Next Level Screening. Alternatives that passed preliminary screening were further ranked for their ability to meet criteria within the 27 study areas.
- Feasibility Study. Ranked list of alternatives for each study area were studied for consideration in the master plan.

Recommendation. Results of the Monroe County Master Plan Feasibility Study concluded that providing community wastewater collection and treatment in most areas of the Keys (25 of the 27 study areas) would be more cost effective and have fewer adverse environmental impacts when compared with upgrading or replacing all existing onsite systems with shared cluster OWNR systems and upgrading all existing wastewater treatment facilities.

2.1.5 Priorities of Proposed Projects

The identification and elimination of presently undocumented treatment systems and associated cesspools that have been in service for a number of years without ever having been permitted has been identified as a priority. In comparison, the annual cost per pound of nitrogen or phosphorus removal was assigned secondary importance. Consequently, the annual cost of removing undocumented treatment systems was identified as the primary criteria in determining the primary need of a community wastewater collection and treatment system and establishing and ranking water quality *Hot Spots*. *Hot Spot* areas generally encompass two or more residential subdivisions and adjacent greenway areas.

Recommendation. As described previously, Monroe County requires that each area of the Keys (Upper, Middle, Lower) establish a priority *Hot Spot* list and initiate planning, design, and construction of community wastewater systems for these areas. The planning, design, and construction of treatment facilities for water quality *Hot Spots* in Monroe County was recommended in order of the priority ranking assigned to the *Hot Spots* as part of the Monroe County master plan.

2.1.6 Proposed Onsite Systems for *Cold Spots*

Properties with *Cold Spots* where onsite systems will continue to operate fall into two categories, as described here.

- Properties with treatment systems of unknown type or origin must replace or upgrade their systems immediately with a nutrient reduction OWNRS by July 12, 2003.
- Properties that currently have permits for their onsite systems and will not be required to upgrade or replace them until 2010, when all onsite systems must be upgraded or replaced with nutrient reduction OWNRS to meet the regulatory effluent limits of 10/10/10/1.

Recommendation. Install OWNRS as prescribed by regulatory requirements and local ordinance.

2.1.7 Wastewater Solids Management

A summary of the solids management plan recommended as part of the Monroe County Master Plan for the 28 existing and proposed wastewater treatment facilities (WWTFs) and the options considered is provided here. Three options were evaluated.

- ***Option 1. Minimum Regionalization***. Operate solids handling facilities at all 14 WWTFs of 100,00 gpd capacity or greater.
- ***Option 2. Maximum Regionalization.*** Operate solids handling facilities only at the largest WWTFs in the Lower, Middle, and Upper Keys with solids from all other WWTFs trucked to these facilities.

- ***Option 3. Intermediate Regionalization.*** Operate solids handling facilities at the nine WWTFs of 400,000 gpd capacity or more, with solids from the remaining plants trucked to the nearest of these facilities.

Recommendation. *Option 1: Operation solids handling facilities at all 14 WWTFs of 100,00 gpd capacity or greater* was recommended as part of the Monroe County Master Plan.

2.1.8 Wastewater Collection Alternatives

Wastewater collection alternatives were analyzed for their suitability in each of the 27 study areas. The collection system technologies that were evaluated are listed below.

- Conventional gravity sewers.
- Simplified gravity sewers.
- Smaller diameter gravity sewers.
- Sewer grinder pump systems,
- Septic effluent pump systems.
- Vacuum sewers.

Of these six collection system types, three systems were found to be best suited for the Florida Keys and were evaluated in more detail: vacuum sewers, grinder pump systems, and progressive cavity grinder pump systems. Conceptual designs for these collection systems were prepared and construction cost estimates developed. In 22 of the 27 study areas, vacuum collection was the lowest cost alternative for serving the entire study area, particularly when the number of equivalent dwelling units (EDUs) collected was more than 350.

Recommendation. In addition to being the most cost-effective collection system alternative, vacuum sewers offer the following advantages:

- No electrical power is required at each home or vacuum value.
- Wastewater collection service is maintained during short-term or long-term utility power losses with a standby generator located at each vacuum station that will automatically be triggered in the event of power loss.
- Air drawn into the vacuum system with the sewage will help to keep the sewage aerated, and thus will help to eliminate odors

2.1.9 Selection of Effluent Disposal Methods

Requirements that prohibit new or increased wastewater effluent discharges into surface waters in Monroe County and mandate the elimination of existing discharges to surface waters by July 1, 2006 were passed by the 1999 Florida Legislature. This legislation allows effluent reuse systems, but requires the use of underground injection for effluent disposal, under the conditions described below.

- *Shallow Injection Wells.* If the design capacity of the facility is less than 1 mgd, the well must be at least 90 feet deep and cased to a minimum depth of 60 feet (this is considered a shallow injection well).
- *Deep Injection Wells.* If the design capacity of the facility is greater than or equal to one mgd, the well must be cased to a minimum depth of 2,100 feet (a deep injection well).
- *Water Reuse.* The Monroe County Master Plan recommended limited use or reliance on effluent reuse and cited the drawbacks outlined here.
    1. Land application requires full storage or backup disposal systems whenever treatment requirements are not achieved, or when the land application site cannot take reclaimed effluent. This includes extended periods of wet weather.
    2. Relatively large tracts of land are required to accommodate the effluent being disposed. Such tracts may be distant from the plant site, causing high transmission conveyance costs.

Recommendation. Design and construct effluent disposal systems in compliance with applicable regulatory requirements.

2.1.10 Monroe County Sanitary Wastewater Master Plan Recommendations

The recommendations presented in this master plan include:

- Upgrade or replace existing onsite systems located in lower density areas of the Florida Keys with onsite nutrient reduction systems (OWNRS)
- Install 12 community wastewater collection and treatment systems.
- Install five regional wastewater collection and treatment systems.
- Continue to operate and upgrade treatment processes for 17 existing facilities to meet BAT or AWT, as required, by July 2010.

The master plan further recommended that five of the 12 community wastewater collection and treatment systems feature interim wastewater treatment facilities that, over time, would be phased into the larger regional systems. Details of the recommendation from the Monroe County Master Plan for each of the three regions of the Florida Keys are presented below.

Lower Keys. In the Lower Keys, construction of four new community wastewater systems and two new regional wastewater systems was recommended. The two proposed regional systems in the Lower Keys are relatively small, in terms of both flow and area served, thus the first phase of these WWTFs can be constructed at the regional WWTF site. Master plan recommendations also include the continued operation and upgrade of seven existing facilities in the Lower Keys to meet the BAT/AWT standard by July 1, 2010.

Middle Keys. Two new community wastewater systems and one new regional system were recommended. . Other than Duck Key, Conch Key, and Long Key/Layton, all study areas of the Middle Keys continue to operate and upgrade their treatment process to meet the BAT/AWT standard by July 1, 2010. These systems include:

- Hawk's Cay (Hawk's Cay portion of AWT upgrade)
- West end Long Key (three facilities)
- East end Long Key (two facilities)

Upper Keys. In the Upper Keys, one new community wastewater system is recommended in lower Matecumbe, and two new regional systems are recommended: the 1.5 million gallon per day (mgd) system to serve Islamorada Regional Wastewater Management District, and the 2.25 mgd system to serve the Tavernier/Key Largo Regional Wastewater Management District.

2.2 Marathon Wastewater Treatment Facilities Plan

A wastewater treatment facilities plan was developed for Marathon for which potential WWTF site locations were evaluated.

2.2.1 Wastewater Treatment Facility Siting Alternatives

This preliminary screening process resulted in identification of 19 potential WWTF sites. These sites were narrowed down through a selection criteria matrix to six sites, including at least three regional WWTF sites (greater than ten acres). The sites with the highest scores in the site selection criteria matrix were selected for further evaluation, including field environmental assessments. Assessed values of the sites were obtained from records of the Monroe County Property Appraiser. The tasks completed as part of the Environmental Assessments of the six selected sites are listed below.

- Review existing Monroe County Land Use Classification Maps.
- Review USEPA Florida Keys Wetlands Advanced Identification Project Land Cover Maps.
- Review any site specific development and proposed development plans available through Monroe County.
- Review the most recent available color infrared and tax assessor aerial imagery.
- Review threatened and endangered species data relative to each selected site.
- Site inspection by a qualified environmental scientist.

Recommendation. Site Number Four (West of 48th Street) was recommended as the first priority site for a regional WWTF. An analysis of collection system alternatives indicated that use of this site will not incur significantly higher collection/transmission system costs than use of the more centrally located Site Number Six. This site has the added advantages of being partially cleared, absent of environmentally sensitive lands, and in proximity to a reclaimed water application site (Sombrero Country Club Golf Course).

2.2.2 Collection System Alternatives

The three wastewater collection technologies identified as best suited for use in the study area were centrifugal grinder pump systems, progressive cavity grinder pump systems, and vacuum sewers. All three technologies are capable of providing reliable wastewater service if properly installed and maintained. Gravity sewers would also provide reliable service, but at a

substantially higher cost than the alternative collection systems. Based on cost estimates prepared for the four collection system options, vacuum sewers were identified as the lowest cost alternative.

Of the three alternative wastewater collection systems, vacuum systems have the greatest system reliability. Vacuum sewers do not require a power source at individual connection points and the system can remain in service during a power outage if auxiliary power is provided at the vacuum stations. Maintenance costs for the wastewater collection system options are similar. Owners and operators of existing systems reported similar frequencies of maintenance calls for the two types of grinder pump stations and the vacuum valves. On the average, repairs to vacuum valves were reported to be less costly than repairs to grinder pump station.

Recommendation. The entity responsible for the wastewater utility should participate in the decision process for selection of the type of collection system to be used. Final selection should be based on cost and on preference of the wastewater utility, provided the difference in cost is not large enough to adversely impact users of the system.

2.2.3 Wastewater Treatment Alternatives

Analysis of potential wastewater treatment alternatives relied on the evaluation of treatment alternatives with varying degrees of effluent water quality over a wide range of capacities. The intent was to screen all potential applications for the study area, although the emphasis was on fundamental processes and not on the diversity of proprietary processes available. Such process variations were left for further evaluation to be undertaken subsequent to establishment of the fundamental process train.

The study area included some 70 FDEP permitted WWTFs. Consideration was given to upgrading one or more of these existing plants for use as a regional or subregional WWTF. The cost estimates developed were based primarily on information provided by a number of equipment vendors. Cost information from prior CH2MHILL projects was also used. Unit sizing criteria were developed in accordance with Ten States Standards. The estimates were prepared to emphasize relative cost differences between the alternatives rather than the absolute magnitude of the costs.

Recommendation. Capital and O&M costs were estimated for each treatment alternative at capacities of 0.02 mgd, 0.10 mgd, 1.0 mgd, and 2.0 mgd. Pre-engineered, field-erected treatment units were assumed for the cost estimates, however, the entity ultimately responsible for wastewater treatment may wish to consider cast-in-place construction. The initial construction cost would be somewhat higher, however, a cast-in-place plant would offer advantages in reduced O&M and increased operational flexibility.

2.2.4 Wastewater Effluent Management Alternatives

Potential effluent management alternatives were identified and were first screened for implementation obstacles and those alternatives with major obstacles were eliminated from further evaluation. Reuse by land application, underground injection through deep wells,

underground injection through shallow wells, and surface water disposal were identified as potentially feasible methods for effluent management in the Marathon area.

Recommendations were made based on four scenarios, described below.

Scenario Number 1. WWTF Capacity of 0.02 mgd. FDEP does not allow reuse for systems this small. A shallow injection well system is the only remaining feasible alternative for effluent management. The order-of-magnitude construction cost estimate for this system was an estimated $33,000 for two wells, wellfield piping, and polishing tank only.

Scenario Number 2. WWTF Capacity of 0.1 mgd. The estimated order-of-magnitude construction cost estimate for the shallow injection wellfield, including four wells, piping effluent, and polishing, was $100,000.

Reuse should be pursued as a secondary effluent management method (0.1 mgd is the minimum allowable size for a reuse system). The order-of-magnitude cost estimate for the reuse system was approximately $1 million for WWTF filters, disinfection, effluent storage tank, continuous on-line turbidity and chlorine residual monitoring equipment, and high service pumping. This cost does not include transmission and distribution piping and connection to the existing irrigation systems. These offsite costs will be determined when site-specific areas for reuse are defined and can be expected to add substantially to the cost of the reuse alternative.

Scenario Number 3. WWTF Capacity of 1.0 mgd. The order-of-magnitude construction cost for the shallow injection well system, including 14 wells, was an estimated $750,000.

Reuse was recommended as the secondary method of effluent management. The order-of-magnitude construction cost estimated for the filters, disinfection, effluent storage tank, continuous on-line turbidity and chlorine residual monitoring equipment, and high service pump station was approximately $2.5 million. Offsite facilities will be evaluated later in the Facilities Plan and will add substantially to the cost of the entire reuse system.

Scenario Number 4. WWTF Capacity of 2.0 mgd. A deep injection well system was recommended as the primary effluent management system. Two injection zones exist and were identified as suitable for wastewater disposal. These constitute the upper part of the Floridan Aquifer System (FAS)and are an intermediate-depth zone, extending from 650 to 1,200 feet below the surface (bls) and the deeper Boulder zone, extending from 2,100 to 2,500 feet bls.

Preliminary design indicates that a 12-inch diameter steel casing set to a depth of approximately 650 feet bls will convey effluent to an injection horizon in the intermediate depth zone. The well will be completed with open-hole construction from 650 to 1,200 feet bls.

Typical surface facilities will include a pump station, surge control system, yard piping, and instrumentation. A second, redundant intermediate depth injection well would provide a back-up system for periods in which the primary injection well is off-line for testing. An order-of-

magnitude construction cost for two intermediate-depth injection wells and surface facilities is approximately $1.52 million, with an annual O&M cost of approximately $90,000.

If the intermediate-depth deep well described above could not be permitted, another potential injection zone exists and is the deeper Boulder Zone. This injection horizon is most likely confined by dense limestone from 1,200 to 2,100 feet bls. This option would include a 22-inch casing set to 650 feet bls, and a 12-inch-diameter casing set to 2,100 feet bls, with open-hole construction to 2,500 feet bls. The estimated order-of-magnitude construction cost for two deep wells and surface facilities is $2.82 million, with an annual O&M cost estimated to be $90,000.

Recommendation. Shallow well injection of wastewater effluent was recommended for three WWTFs with capacities less than or equal to 1.0 mgd, and deep well injection for WWTFs with capacities of 2.0 mgd. Reuse of effluent was recommended as a secondary effluent management method, if economically feasible.

2.2.5 Solids Management Alternatives

Alternatives for processing and disposing of residual wastewater solids (treatment facility sludge and septage) generated as a result of implementation of regional or subregional wastewater collection and treatment systems were evaluated. The alternatives evaluated included various processes for stabilizing, dewatering, transporting, and disposing of solids produced by two WWTFs serving the primary and secondary service areas. Alternative means of handling treatment facility solids and septage from the remaining areas of the planning area were also evaluated.

In general, proven solids handling processes in the United States today were first screened with respect to their applicability at a new regional WWTF serving the primary service area. For the wastewater collection/treatment option using subregional WWTFs, it was assumed that a single centralized solids handling facility would be constructed at one WWTF site, and solids from the other WWTFs would be transferred to that site for processing. The most feasible processes were then formulated into alternative systems, which were compared on the basis of both capital and O&M costs.

Recommendation. A residual solids handling system consisting of aerobic digestion, dewatering, and contract hauling to remote agricultural land was recommended for a new regional WWTF. The regional WWTF or central subregional solids management facility should also be equipped to receive and co-process residual solids from the Key Colony Beach and Hawks Cay WWTFs serving the secondary service area. Continued disposal of residual solids to the Miami-Dade Water and Sewer Department (MDWASD) using contract haul services was also recommended.

2.2.6 Wastewater Management Alternatives

Wastewater management alternatives were evaluated to identify the most cost-effective and environmentally favorable plan for wastewater management in the Marathon Study Area. The three alternatives examined are listed here.

- Upgrade individual onsite systems with Best Available Technology (BAT) and upgrade existing package plants to Advanced Wastewater Treatment (AWT) standards.
- Serve the primary service area with subregional WWTFs.
- Serve the primary service area with a regional WWTF.

All regional management alternatives were evaluated on the basis of providing AWT where treatment facility flows were greater than 100,000 gpd in accordance with the Monroe County BOCC's selection of AWT as the most environmentally sound treatment level. Alternatives were evaluated on the basis of cost and environmental and implementation factors.

Depending on the size of the initial reuse capacity at the regional plant, additional capital costs could vary from approximately $2,050,000 to $10,500,000. Total project costs could vary from approximately $2,600,000 to $13,400,000; these costs would have to be included and financed in the total project cost of the regional facility. Annual O&M costs would increase between $18,000 and $50,000.

Recommendation. A recommendation for a legally binding commitment by customers to use reuse waster at a guaranteed level should be obtained before any reuse facilities are incorporated into the design and construction of the reuse facility. Based on these commitments, the initial reuse demand and the size and extent of the initial reuse facility can be determined and incorporated into the project.

2.3 Islamorada Village of Islands, Stormwater Management Master Plan

To evaluate potential reductions in pollutant loads from storm events in the Islamorada Village of Islands (Village), an analysis of pollutant load reduction scenarios was conducted for each of the drainage basins. The qualitative aspects of various attributes for each alternative treatment technology were evaluated with regard to program priorities and future land use projections. When present, environmental impacts for each alternative were evaluated on the basis of their potential affects on natural resources, including flora and fauna, water and sediment water quality standards; habitat communities, and unique physical features of the environment within each basin as they relate to future land use activities. The ten alternative pollutant load reduction scenarios were evaluated and are listed below.

1. Installation of sediment removal mechanisms.
2. Installation of drainage wells and associated sediment removal mechanisms.
3. Construction of swales.
4. Installation and maintenance of native vegetative buffers.
5. Construction of retention/detention facilities.
6. Wetland hydrologic enhancement.
7. Creation of wetland habitats.
8. Infrastructure/system maintenance.
9. Public education.
10. No action.

A ranking system was developed to assess the relative degree of potential adverse environmental impacted and reduction of pollutant loadings associated with each of the ten alternatives listed above. The alternatives were ranked on a scale of one to five, with five being the most desired ranking or representing negligible adverse environmental impacts, and one where significant ecosystem impacts were anticipated, or estimated costs were disproportionate to benefits.

Each alternative was ranked with regard to categories of:

- Water quality (e.g. nutrient loading; suspended solids; oil and grease; and heavy metals),
- Physical parameters (e.g. maintenance; public safety; and erosion and sedimentation),
- Sediment storage capacity,
- Flora and fauna (e.g. avifauna; fish; benthos; and threatened/endangered plant and animal species),
- Alteration of coastal habitats,
- Land use,
- Level of Service provided (water quality and quality discharge requirements of the Village Comprehensive Plan), and
- Relative cost.

The categories were then averaged to determine the final ranking of each ten alternatives for each of the Village's 13 proposed future land use categories. The result was a recommended strategy for reduction of pollutant loads for each land use type.

Each drainage basin may contain one or more land use types. As stated above, for each land use type a preferred methodology for pollutant reduction was developed. Each drainage basin was then ranked with regard to priority for implementation of pollution reduction measures based on the improvement's ability to meet Program Priorities developed by the Village and the potential benefits of the improvements.

Recommendation. A priority list of 63 projects developed as part of the master plan was recommended for implementation over 30 years with an associated cost in current dollars of $48,916,882.

2.4 Monroe County Stormwater Management Master Plan (SMMP)

2.4.1 Goals and Objectives of the Master Plan

Based on public input and the 2010 Comprehensive Plan, the following is a list of recommended goals and objectives for the Monroe County Stormwater Management Master Plan.

Goal 1. Identify, assign priority and recommend remedial improvements for the water quality related problem areas in unincorporated areas of the County.

Goal 2. Provide recommended actions that will reduce the sediment and nutrient loading of nearshore waters resulting from runoff.

Goal 3. Review existing regulatory requirements for the control of new development related to flooding and water quality and recommend improvements as needed. As a related issue, the SMMP will review existing enforcement activities and recommend changes necessary to improve the compliance of existing or new regulations.

Goal 4. Recommend activities related to the stormwater management of future growth that will be expected to result in no increase in sediment or nutrient loads to nearshore waters.

Goal 5. Encourage the use of nonstructural and source controls to achieve a reduction in existing sediment and nutrient loads and, when necessary, recommend structural controls associated with the publicly owned infrastructure.

2.4.2 Alternatives Considered

As part of this plan, various alternative strategies for stormwater management with particular emphasis on those to be used in the Monroe County Stormwater Management Master Plan were considered.

2.4.2.1 Onsite Approach.

In the case of future urban development or retrofit of existing development, the onsite approach (also known as piecemeal approach to stormwater control) involves the delegation of responsibilities for BMP deployment to local land developers or the use by the County of BMPs serving small areas due to site constraints. Each developer is responsible for constructing a structural BMP at the development site to control nonpoint pollution loadings from the site. Onsite detention ponds typically have contributing areas of 20-50 acres. The local government is responsible for reviewing each structural BMP design to ensure conformance with specified design criteria, for inspecting the constructed facility to ensure conformance with the design, and for ensuring that a maintenance plan is implemented for the facility. The treatment facility usually consumes 15% of developable site based on research done in Florida by CDM and others.

2.4.2.3 Regional Approach.

The regional approach to stormwater control involves strategically locating regional structural BMPs to control nonpoint pollution loadings from multiple development projects. For ponds serving new development, the front-end costs for constructing the structural BMP are assumed by the developer and/or the local government that administers the regional BMP plan. BMP capital costs can then be recovered from upstream developers on a "pro-rata" basis as development occurs. Individual regional BMPs are phased in as development occurs rather than constructing all regional facilities at one time. Maintenance responsibility for regional structural BMPs can be assumed by the developer (or designee with certified maintenance bonds) or by the local government. For retrofit of existing development, regional BMPs may also be used to cost-effectively treat areas near the areas that cannot be cost-effectively treated. The regional approach can address concurrence for the entire watershed.

2.4.2.3 BMP Alternatives

The study listed 19 structural BMPs and 16 nonstructural source controls considered for the Florida Keys.

Structural BMPs

- Shallow grassed swales
- Retention basins
- Buffer strips
- Porous pavement
- Water quality inlets and baffle boxes
- Hydrodynamic separators
- Underdrains and stormwater filter systems
- Infiltration drainfield
- Dry wells
- Modular treatment systems
- Stormwater wetlands
- Alum injection systems
- Aeration
- Level spreaders
- Oil/grease separators
- Recharge wells and bore holes with pretreatment

Nonstructural Stormwater Controls

- Land use planning
- Public information programs
- Stormwater management ordinance requirements
- Fertilizer application controls
- Pesticide use controls
- Control of gray water (cisterns and Rain barrels)
- Solid waste management
- Hazardous materials management
- Street sweeping
- Vehicle use reduction
- Directly connected impervious area (DCIA) minimization
- Low impact development
- Illicit connections (non-stormwater discharges) identification and removal
- Erosion and sediment control on construction sites
- Source control on construction sites
- Operation and maintenance

Bridges

The Monroe County Stormwater Master Plan lists the islands along U.S. 1 in the Monroe County study area and associated bridges and bridge lengths connecting them (lengths given to the nearest 0.1 mile). Of the 107 miles of U.S. 1, 18.9 miles (about 18 percent) are bridges of various lengths. Approximately 17 miles of bridges and potential stormwater runoff retrofit are addressed as part of the Plan.

The bridges represent 100 percent impervious surface and runoff to nearshore waters or bridge land fall. As a result of concerns over treatment of this stormwater, the U.S. Geological Survey conducted a study of the Bayside Bridge in Clearwater, Florida from 1993 to 1995 (Stoker 1996). For the Bayside Bridge, stormwater runoff was collected along the bridge through inlets, and conveyed to a land-based detention facility near the bridge entrance. The study monitored 33 storm events and found that stormwater runoff quality varied with total runoff volume, antecedent dry period, and season. Many parameters, including sediments and nutrients, were inversely related to runoff volume. Treatment efficiencies indicated that suspended solid loads were reduced by 30 to 45 percent, inorganic nitrogen by 60 to 90 percent and most metals by 40 to 99 percent. However, outflow concentrations were greater than inflow concentrations for total Kjeldahl nitrogen (TKN), alkalinity, pH, specific conductance, and other water quality parameters.

The study concluded that: 1) stormwater should be conveyed to and treated at land based facilities; 2) regular maintenance is necessary, and 3) treatment efficiencies are highly variable and some constituent concentrations increase. While similar studies have not been performed in the Keys, bridge runoff control was not recommended on a large scale. Implementation on a trial basis at one or more sites for a few years, with monitoring, was recommended, and depending on the outcome, bridge runoff control could be implemented on selected bridges.

Recommendation. Based on an analysis of the benefits and costs, retrofit and rehabilitation projects were recommended for areas with documented water quality problems and projects were recommended that:1) would retrofit and rehabilitate areas with flooding and water quality problems that would be of public concern; 2) improve maintenance for existing and future stormwater management facilities, and 3) minimize stormwater-associated pollutant loading to nearshore waters from existing and future developments and other sources. The following actions were recommended.

- *Monroe County should adopt a 95 percent treatment requirement and strictly enforce its application on new development and significant redevelopment.* This means that new developments must remove 95 percent of the annual average load of pollutants from developed property. For the purposes of this plan, the 95 percent standard means 95 percent capture of the mean annual rainfall volume. Stormwater pollutant loading models for future growth indicate that this will achieve Goal 4 (no increase in future loads). The anticipated consequences of this requirement are first, the County should review each new development to confirm that the 95 percent requirement is met and through construction inspection, confirm that the stormwater systems are being built according to